

What is claimed is:

1        1. A method for mapping surface topography of a substrate comprising:

2            forming a non-metallic film over a substrate;

3            forming a metal film over said non-metallic film;

4            polishing to remove at least a portion of said metal film; and

5            distinguishing first regions in which said metal film remains, from second regions

6        in which said metal film has been removed and said non-metallic film is exposed.

1        2. The method as in claim 1, wherein said forming a non-metallic film over a

2        substrate comprises forming a dielectric film over a semiconductor substrate.

1        3. The method as in claim 1, wherein said substrate includes at least one

2        further film formed thereover, and said forming a non-metallic film comprises forming a

3        dielectric film over said at least one further film.

1        4. The method as in claim 3, wherein said at least one further film includes a

2        patterned polysilicon film and a polished interlevel dielectric film formed thereover.

1        5. The method as in claim 3, wherein said polishing and said distinguishing

2        take place during in-line processing of semiconductor devices being formed on said

3        substrate and further comprising generating topographical data of a surface of said

4        substrate.

1        6. The method as in claim 1, wherein said forming a metal film comprises

2        forming a copper film.

1        7. The method as in claim 1, wherein said polishing comprises chemical

2        mechanical polishing (CMP).

1        8. The method as in claim 1, wherein said distinguishing includes using an

2        interferometer to monitor optical signals directed to a top surface of said substrate.

1           9. The method as in claim 1, wherein said distinguishing is repeated  
2 periodically during said polishing.

1           10. The method as in claim 1, wherein said distinguishing is repeated  
2 substantially continuously during said polishing.

1           11. The method as in claim 10, wherein said distinguishing includes spatially  
2 distinguishing said first regions from said second regions a plurality of times during said  
3 polishing, and further comprising generating a three-dimensional topographical map of  
4 said substrate based on said distinguishing.

1           12. The method as in claim 1, wherein said distinguishing includes directing  
2 an optical signal to a top surface of said substrate and using an interferometer to detect  
3 one of a return refracted signal and a return reflected signal.

1           13. The method as in claim 12, wherein said directing an optical signal  
2 includes causing said optical signal to scan across said top surface.

1           14. The method as in claim 1, further comprising generating a map of  
2 substrate topography based on data obtained during said distinguishing.

1           15. The method as in claim 14, further comprising instituting in-line process  
2 controls based on said map.

1           16. The method as in claim 14, wherein said first regions correspond to  
2 relatively depressed regions of said substrate and said second regions correspond to  
3 relatively raised regions of said substrate.

1           17. The method as in claim 1, wherein said substrate is generally round and  
2 includes a diameter of about 12 inches and said distinguishing includes monitoring  
3 optical signals directed to a plurality of locations, each of said plurality of locations  
4 separated from other of said plurality of locations by about 10-20 mm.

1           18. The method as in claim 1, wherein said substrate comprises a  
2 semiconductor substrate upon which a plurality of semiconductor devices are being

3 formed, and said distinguishing includes monitoring optical signals directed to a plurality  
4 of scribe lines between respective semiconductor devices of said plurality of  
5 semiconductor devices on said semiconductor substrate.

1 19. A method for mapping surface topography of a substrate comprising:

2 forming a non-reflective film over a substrate;  
3 forming a reflective film over said non-reflective film;  
4 polishing to remove at least a portion of said reflective film; and  
5 distinguishing first regions in which said reflective film remains, from second  
6 regions in which said reflective film has been removed and said non-reflective film is  
7 exposed.

1 20. An apparatus for in-line monitoring of surface topography of a substrate  
2 comprising:

3 a body for receiving a substrate thereon;  
4 polishing means for polishing a surface of said substrate; and  
5 detecting means for detecting a presence or absence of a reflective film at a  
6 plurality of locations on said surface during said polishing operation.

7  
1 21. The apparatus as in claim 20, wherein said detecting means comprise an  
2 optical system.

3  
1 22. The apparatus as in claim 20, wherein said detecting means comprise an  
2 interferometer.

3  
1 23. The apparatus as in claim 20, wherein said polishing means comprise a  
2 chemical mechanical polishing apparatus.

1        24. The apparatus as in claim 20, wherein said detecting means detects a  
2 presence or absence of said reflective film at a plurality of locations on said surface,  
3 several times during a polishing operation.

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1        25. The apparatus as in claim 20, further comprising display means that  
2 provide an output indicative of topography of said substrate.

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1        26. The apparatus as in claim 25, in which said display means is coupled to  
2 electronic circuitry that compares said output to pass/fail criteria.